

# HUMAN NAVIGATION, MEG & fMRI RESULTS



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# Navigation System

- ◆ What Defines Navigation ?
- ◆ Higher Cognitive Process
- ◆ Hippocampus



*"Place Cells" \**

*"Head Direction Cells" \*\**

\* John O'Keefe, *et. al.*, *Brain Res.*, **34**, 171 (1971)

\*\* Jeffrey Taube, *et. al.*, *J. Neurosc.*, **10**, 420 (1990)

# Rationale for an MEG and fMRI study

- ✓ Non-invasive
- ✓ Excellent spatiotemporal resolution
- ✓ Possibility of sources localization
- ✓ Include appropriate control studies
- ✓ Ability to extend the duration of the studies

# Task Design

## Virtual Reality City

11 Subjects

2x37 Channel 1<sup>st</sup> Gradiometers  
Covering Temporal Hemispheres

Parse recording into 4 epochs:

- 1) Base Line
- 2) Navigate before the Block\*
- 3) Stop & Visualize path
- 4) Resume navigation\*



# Power Spectrum Density

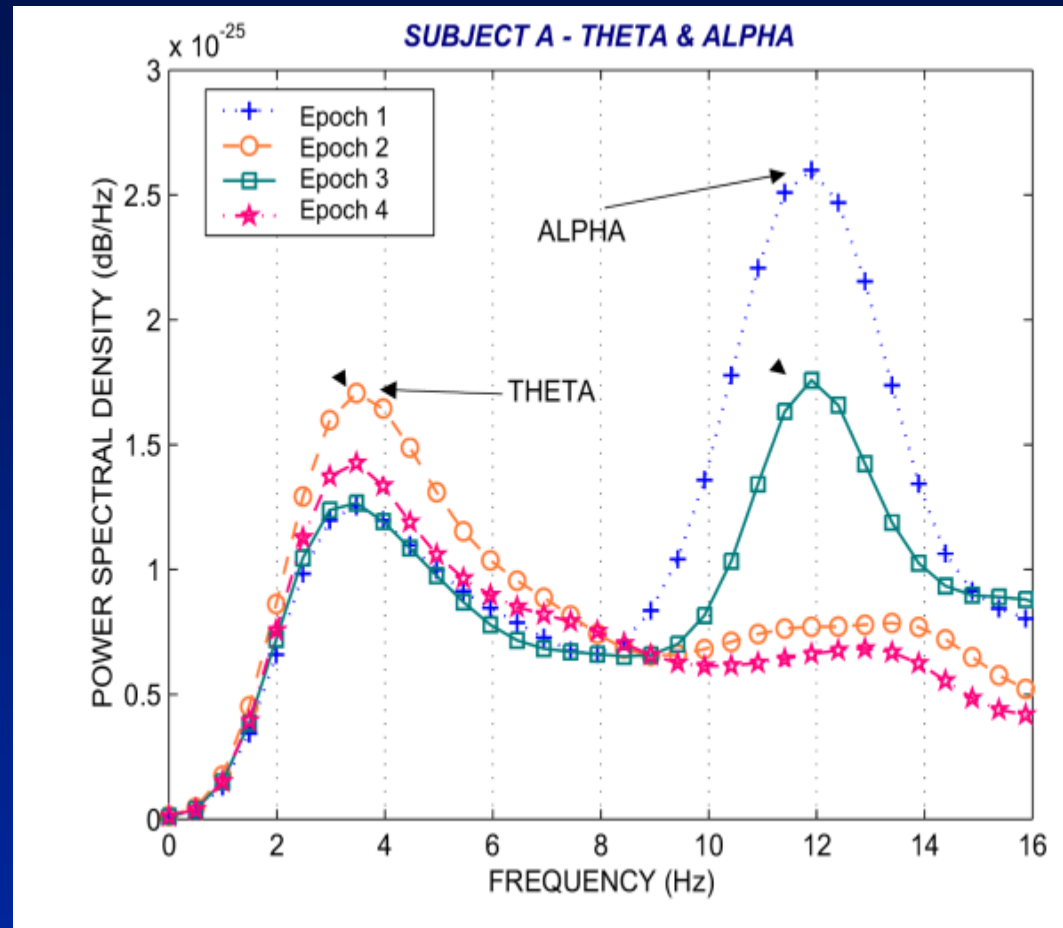
## ◆ Power Spectral Density

### ■ Artifact rejection:

- Blinking
- Heart

### ■ Window FFT:

- Type : Hanning
- Resolution
  - Aprox. 1 Sec.
- Overlapping
  - None



# Theta band (4 - 7 Hz)

✓ Classical 4 Hz - 7 Hz

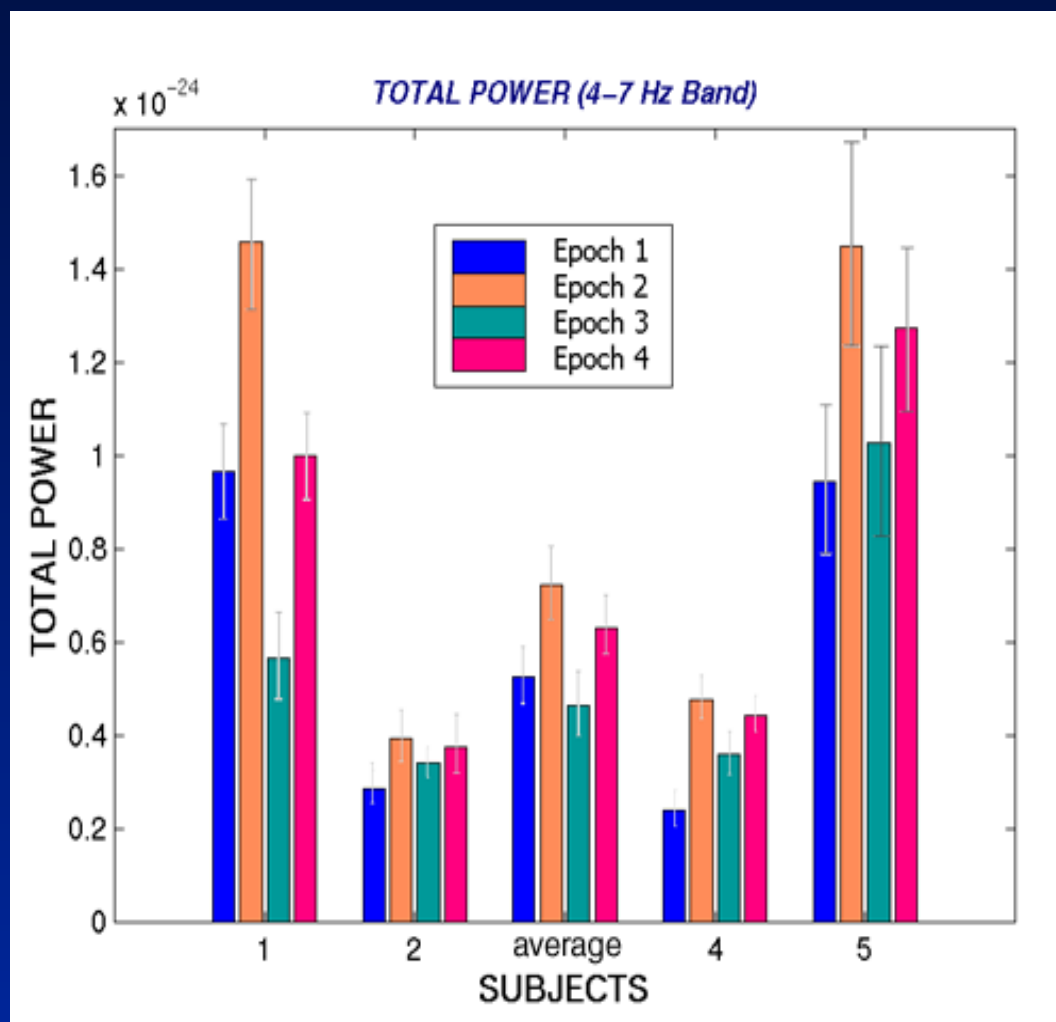
✓ Average of 4 Runs

✓ Low theta power

epoch 1 & 3

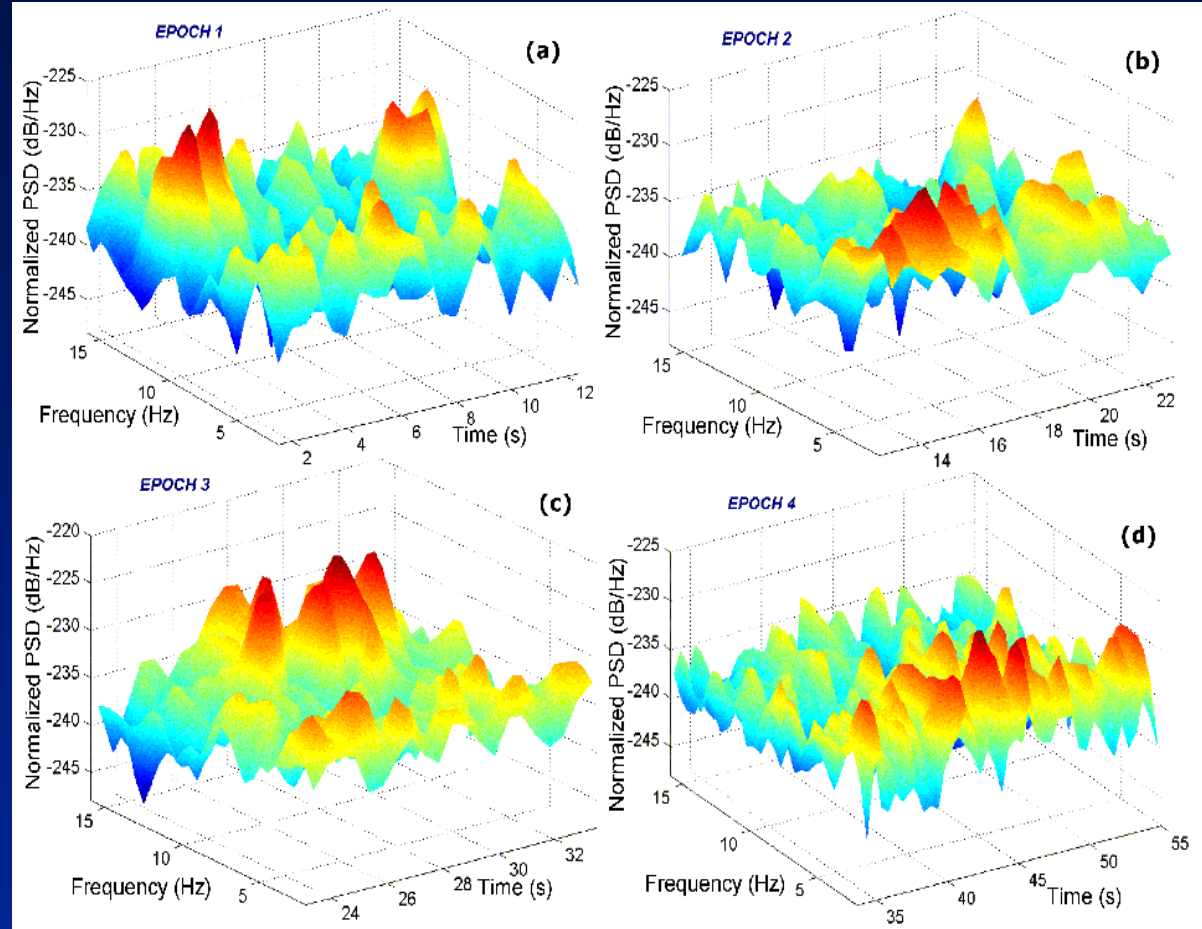
✓ High theta power

epoch 2 & 4



# Spectrogram

- ◆ Smooth  $\alpha$  to  $\theta$  transitions
- ◆ Epochs 1 & 3
  - Theta dominance
- ◆ Epochs 2 & 4
  - Alpha dominance



# Localization - MSI

- ✓ Simple Model Dipole

- ✓ Dipole Density Plot

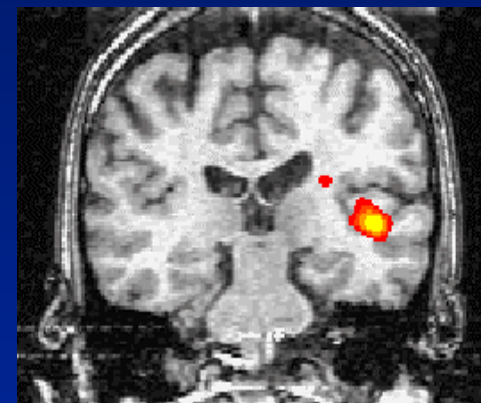
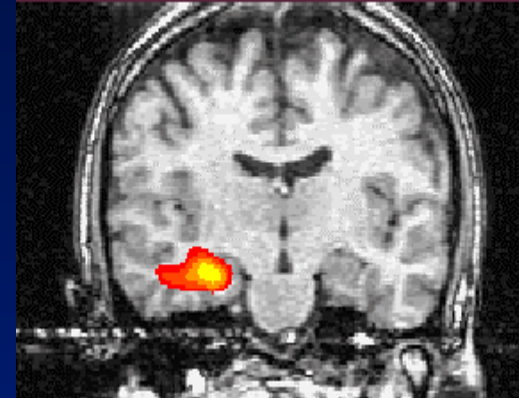
  - Gaussian filter

  - 2 mm resolution

- ✓ Main Areas

  - Superior temporal Gyrus

  - Deeper temporal structures





# Control Studies

## ⇒ MEG probe positioning

⇒ Temporal Areas

## ⇒ 3 Different control studies

⇒ Frontal Midline Theta

⇒ Increase in EEG - Fz

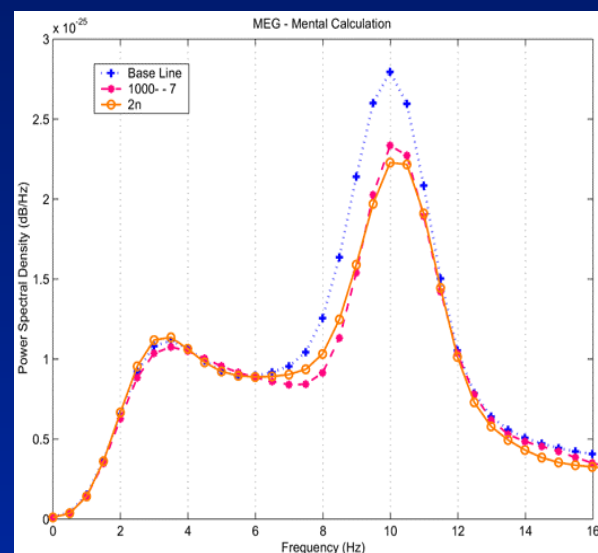
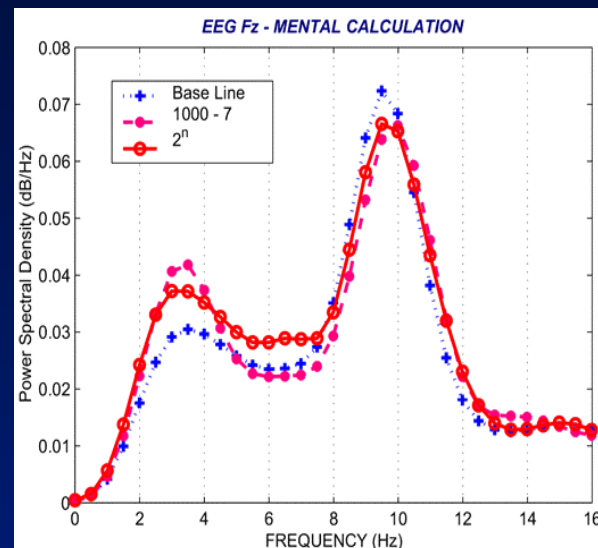
⇒ No increase in the MEG

⇒ Motor Task

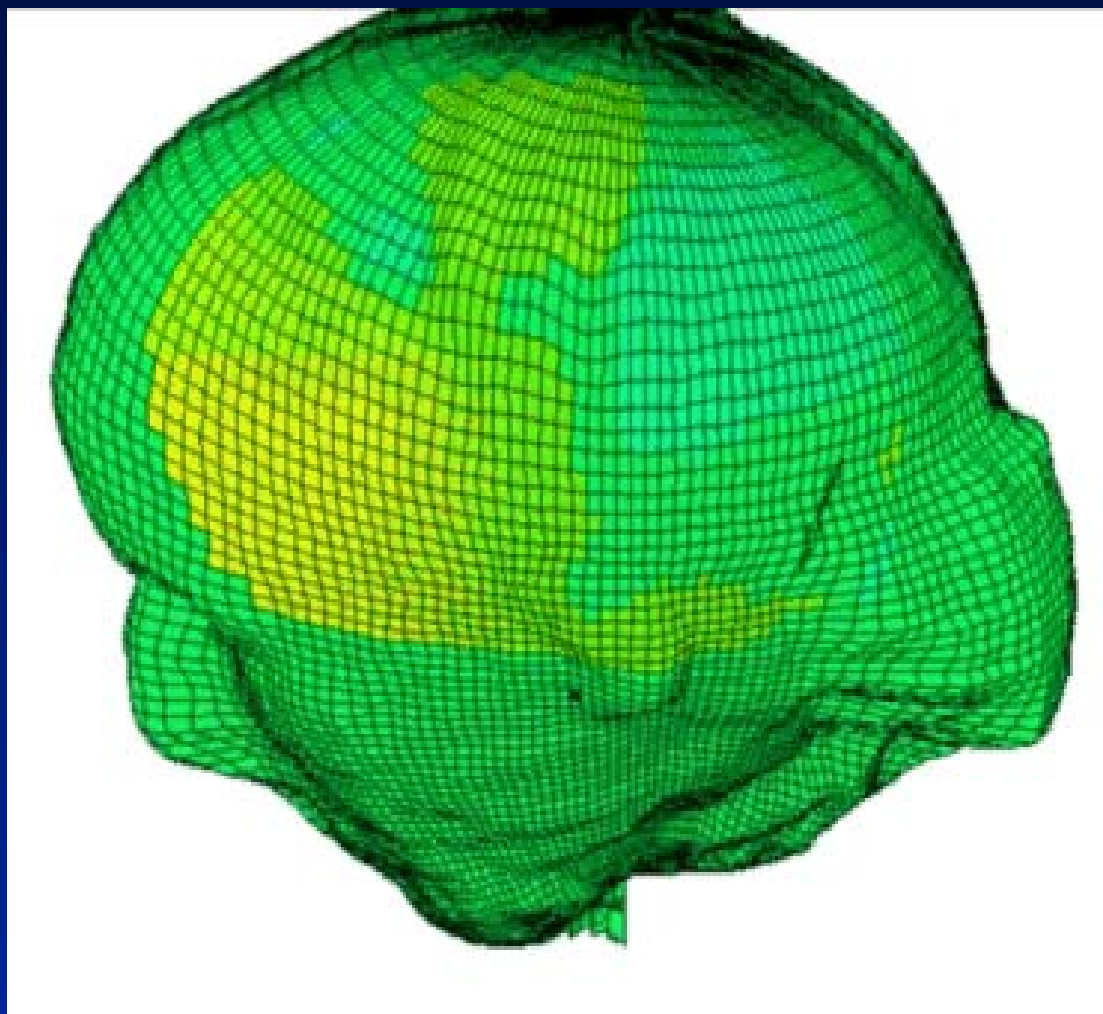
⇒ No increase in the MEG

⇒ Passive viewing

⇒ No increase in the MEG

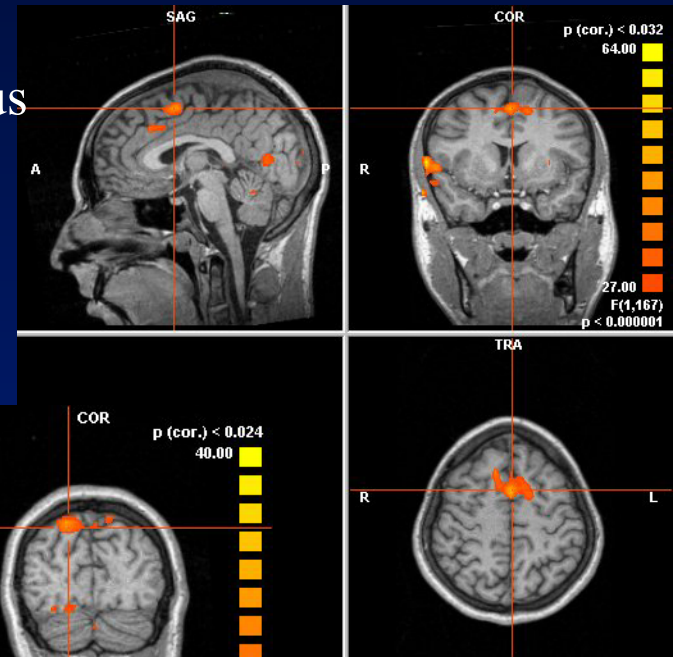
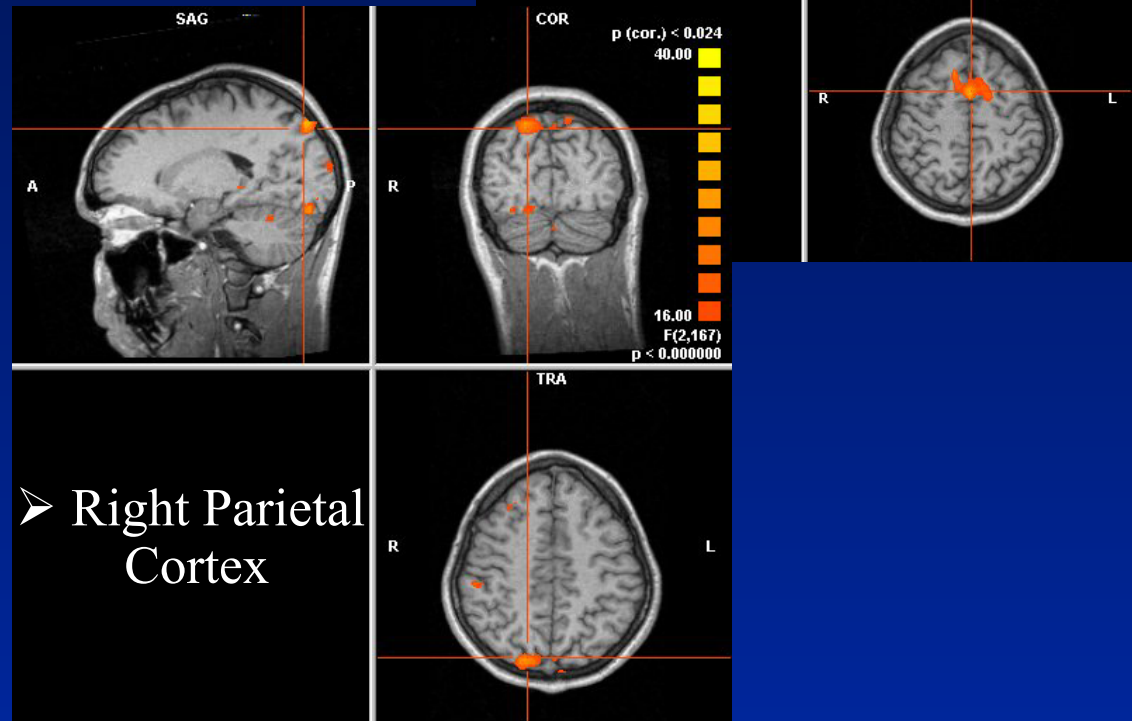
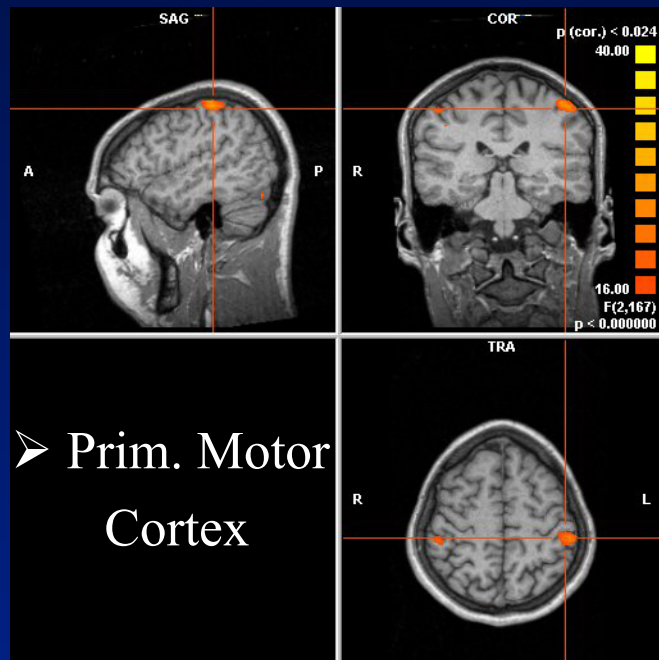


# Dipole Pattern



# fMRI: Preliminary Results

- Cingulate Gyrus
- SSMA Cortex



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